

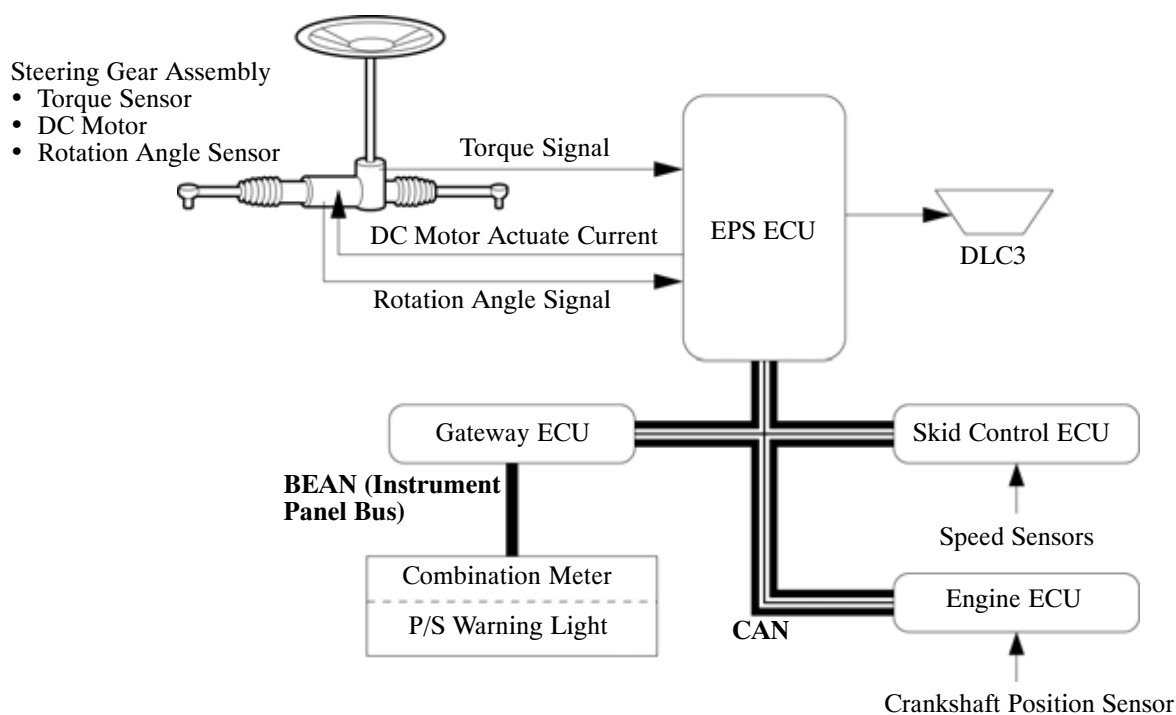
■ EPS (ELECTRIC POWER STEERING) SYSTEM

1. General

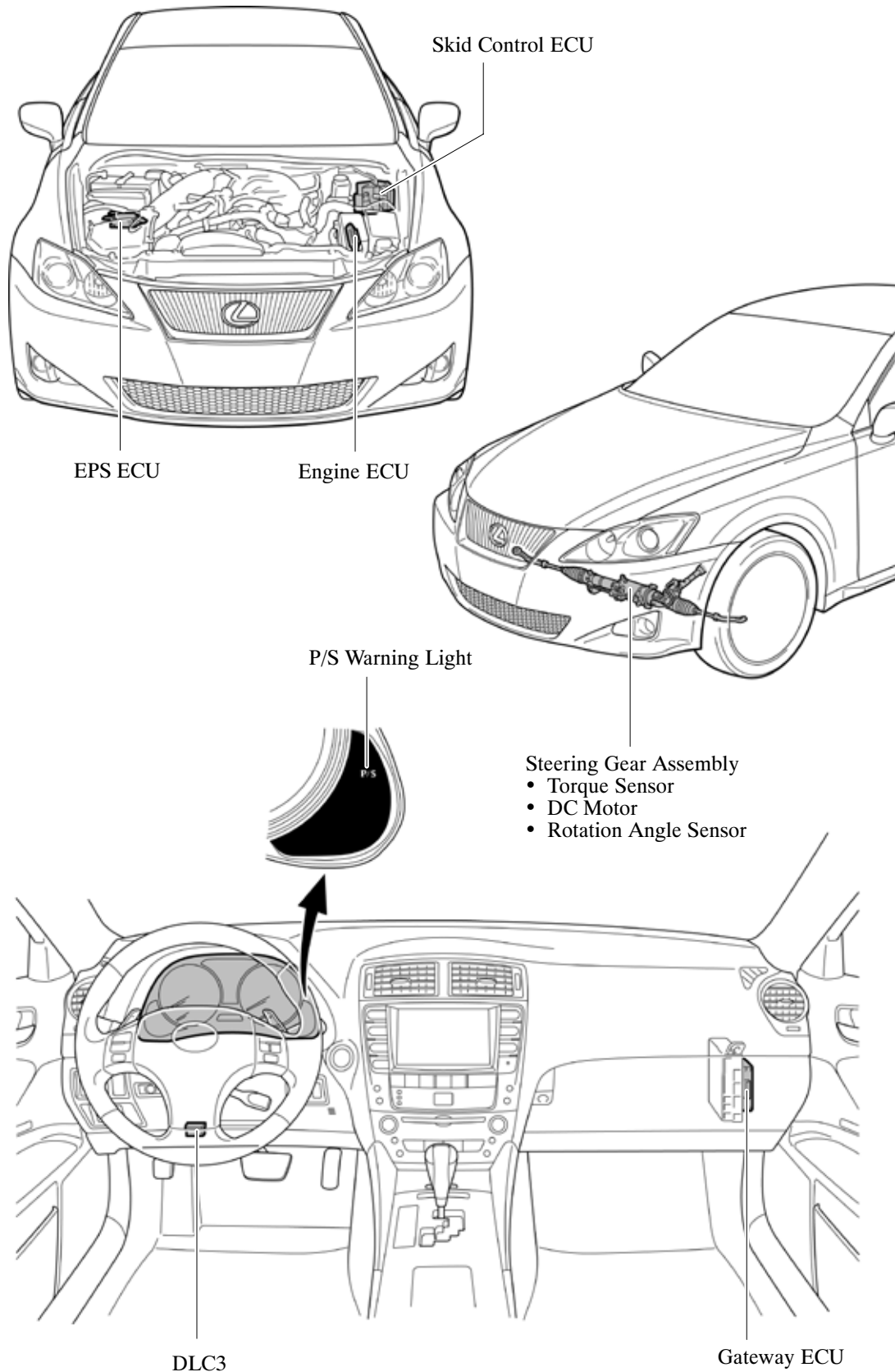
Electric power steering system uses a DC motor and a reduction mechanism that are built into the steering gear housing to generate assist torque, in order to assist the driver's steering effort.

- The EPS system actuates the motor only during steering when torque assist is required. As a result, the EPS system does not consume any energy during straight line driving, thus realizing fuel economy.
- The EPS ECU controls this system.

► System Diagram ◀



2. Layout of Main Component



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3. Function of Main Component

Component	Outline
Steering Gear Assembly	Reduces the speed of the motor and transmits it to the rack shaft.
Torque Sensor	By detecting the twist of the steering torsion bar, the sensor indicates the torque that is applied to the torsion bar by outputting an electrical signal, and this signal is received by the EPS ECU.
DC Motor	Generates power assist in accordance with the actuate current received from the EPS ECU.
Rotation Angle Sensor	Transmits the rotation angle of the DC motor to the EPS ECU.
EPS ECU	• Actuates the DC motor to provide power assist, based on the signals received from various sensors. • When the EPS ECU detects an EPS system malfunction, it outputs a warning signal to the combination meter.
Combination Meter • P/S Warning Light	Upon receiving a signal from the EPS ECU in the event of a system malfunction, the meter ECU illuminates the P/S warning light.
Skid Control ECU	Transmits speed sensor signals to EPS ECU.
Engine ECU	Transmits the engine speed signal to EPS ECU.

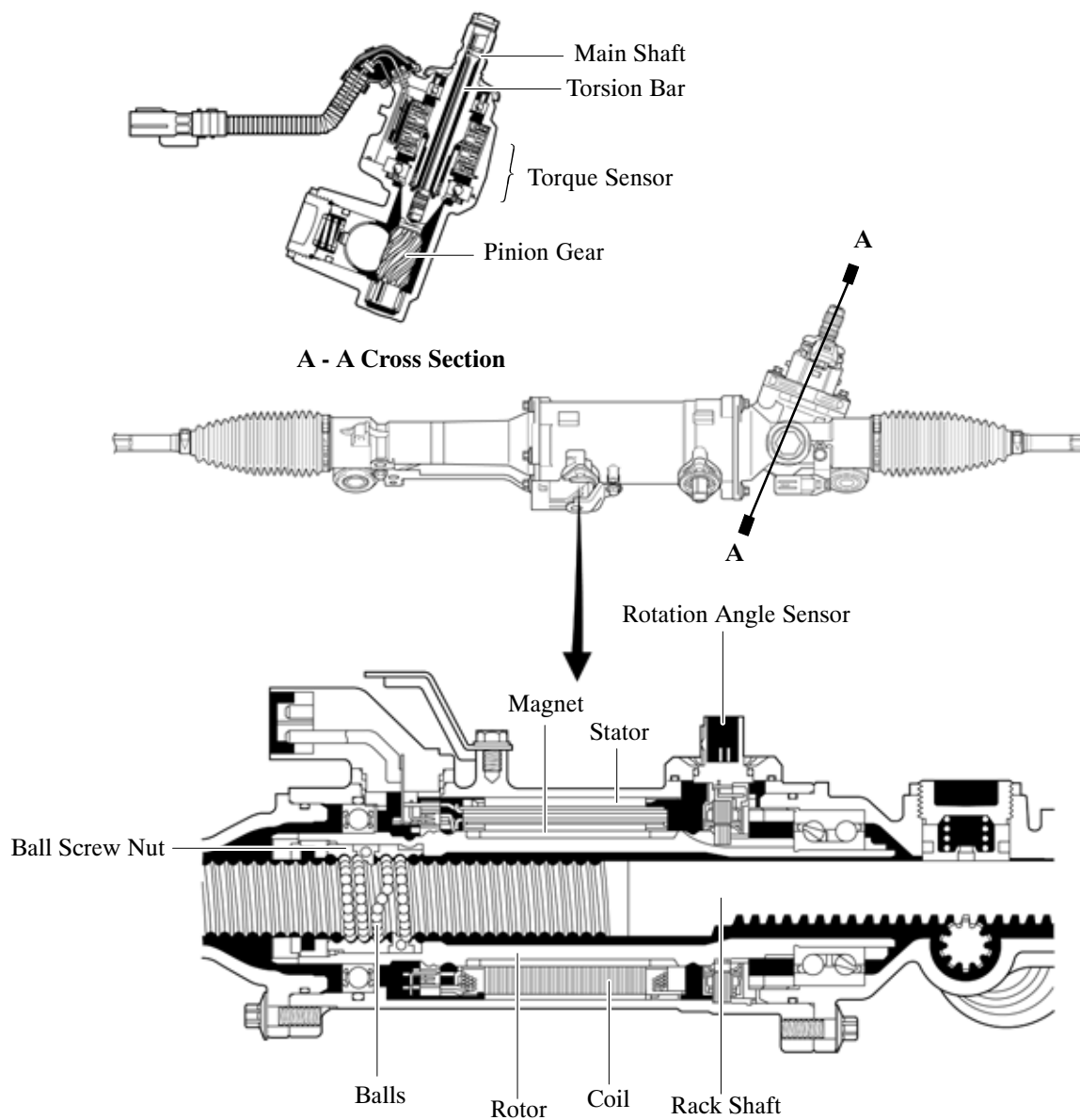
4. Construction and Operation

Steering Gear Assembly

1) General

The steering gear assembly consists of the rack shaft, reduction mechanism, pinion gear, torsion bar, DC motor, rotation angle sensor and torque sensor.

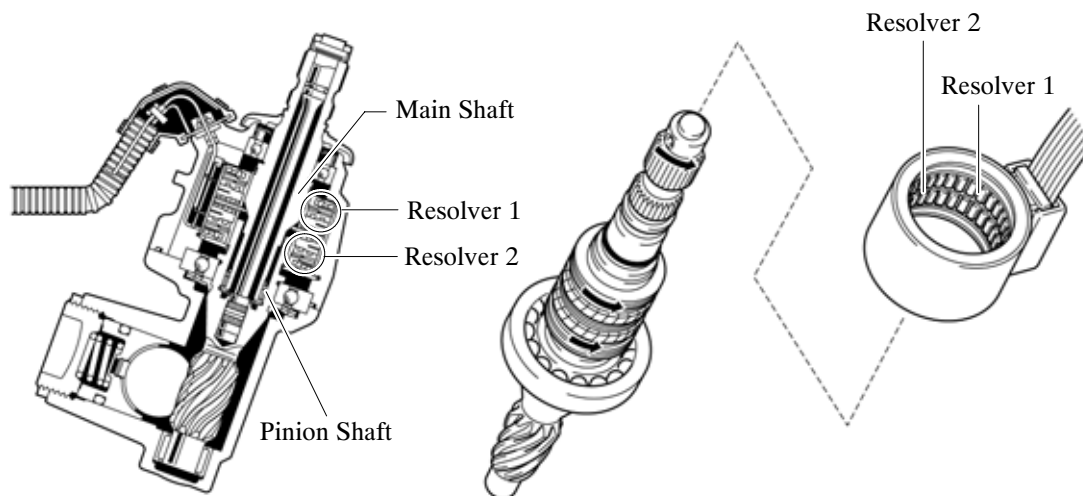
- The reduction mechanism consists of balls and ball nut. The balls and ball contact surfaces are processed with a high degree of accuracy to achieve high efficiency and low noise.
- The DC motor is a high power output and brushless type.
- The DC motor is located around the rack shaft. The motor consists of a magnet, coil, stator, and rotor.
- The ball screw nut secured to the rotor transmits rotational torque from the rotor to the balls. The balls then transmit the rotational torque to the rack shaft.



2) Torque Sensor

Torque sensor consists of resolver 1 and resolver 2.

- Resolver 1 is mounted to the main shaft on the input side. Resolver 2 is mounted to the pinion shaft on the output side.
- These resolvers convert twisting force on the input and output sides of the torsion bar into electric signals and transmit these signals to the EPS ECU.
- The signals sent from the input and output sides differ depending on the amount of twisting force. The EPS ECU calculates the torque value based on the differences in these signals.



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5. System Control

General

The EPS system has the following controls:

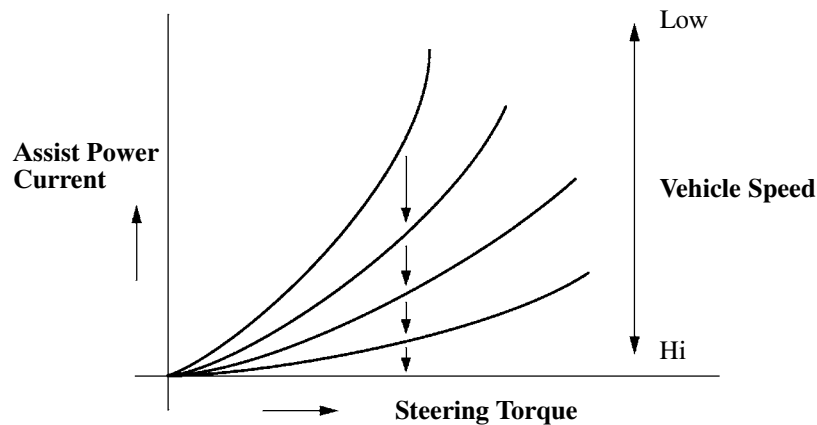
Control	Outline
Basic Control [See page CH-111]	Calculates the assist current required based on the steering torque value and the vehicle speed, and actuates the DC motor.
Inertia Compensation	Improves the starting interval movement of the DC motor when the driver starts to turn the steering wheel.
Returnability Control	Improves returnability during steering wheel operation.
Damper Control	Regulates the amount of assist when the driver turns the steering wheel while driving at high speeds, thus damping the changes in the yaw rate of the vehicle body.
Voltage Boost Control	Boosts the battery voltage in the EPS ECU. It is maintained at 0 volts when the driver is not turning the steering wheel or when the vehicle is being driven straight. It effects variable control between 27 to 34 volts in accordance with the load, when the driver is turning the steering wheel.
System Overheat Protection Control	Estimates the motor temperature based on the amperage and the current duration. If the temperature exceeds the standard, it limits the amperage to prevent the motor from overheating.
Fail-safe	When the EPS ECU detects a malfunction in the EPS system, the ECU changes the control mode to a fail-safe mode, thus enabling the vehicle to be driven.
Diagnosis	If the EPS ECU detects a malfunction in the system, the EPS ECU makes the P/S warning light flash to warn the driver and stores the DTCs (Diagnostic Trouble Codes) in memory.

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Basic Control

The EPS ECU receives the vehicle speed signal and signals from various sensors. Based on these signals, the EPS ECU judges the current vehicle condition, and determines the assist current to be applied to the motor.

- The diagram on the below describes the relationship between the steering torque and the assist power current.



Fail-safe

Fail-safe operation modes are as follows:

Item	Control
Torque Sensor System Malfunction	Disables the assist.
Rotation Angle Sensor Malfunction	Disables the assist.
DC Motor Overheating	Limits the assist force.
DC Motor Short (including drive system malfunction)	Disables the assist.
DC Motor Overcurrent	Disables the assist.
EPS ECU Overheating	Limits the assist force.
EPS ECU Internal Temperature Sensor System Malfunction	Limits the assist force.
EPS ECU System Malfunction (including boost circuit system malfunction)	Disables the assist.
Vehicle Speed Signal Malfunction	Limits the assist force.
Power Supply Voltage Malfunction	Pauses the assist. (Provides normal assist after the voltage recovers.)

Diagnosis

If the EPS ECU detects a malfunction in the EPS system, the EPS ECU flashes the P/S warning light in order to alert the driver. At the same time, DTCs (Diagnostic Trouble Codes) are stored in memory. DTCs can be read by the use of the intelligent tester II. For details, see the LEXUS IS250 Repair Manual (Pub. No. RM0150E).